Appendix D Hazardous Materials Technical Appendix

PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: Current Operations

Summary of Frequency Inputs Lifetime Average oil production, bpd 30 3000 years, estimated bpd over lifetime (oil only), estimated

Platform Holly and Pipeline Summary	Current	Current
Scenario	Freq, per year	Lifetime Prob, %
Small Spills		
Holly - Blowouts any	1.42E-02	34.7
Holly - Wellhead Area Spill to Ocean - leak	2.21E-03	6.4
Holly - Separator Failure Spill to Ocean - leak	1.98E-03	5.8
Holly - Pumping and Shipping Spill to Ocean - leak	3.53E-02	65.3
Holly - Diesel Fuel Loading - Spill to Ocean	2.29E-01	99.9
Holly - misc material spills	2.73E-01	100.0
Pipeline - leaks	3.93E-02	69.2
Cumulative Small Spills	5.95E-01	100.0
Large Spills		
Holly - Blowouts catastrophic	5.68E-03	15.7
Holly - Wellhead area - rupture	6.28E-05	0.2
Holly - Separator Failure Spill to Ocean - rupture	6.57E-04	2.0
Holly - Pumping and Shipping Spill to Ocean - rupture	5.19E-04	1.5
Holly - External impact	1.00E-05	0.0
Pipeline - ruptures	8.14E-03	21.7
Cumulative Large Spills	1.51E-02	36.4

Detailed Calculations					
PLATFORM HOLLY					
Description	Base rate	Units	Multiplier	Rate	Ref
Holly - Blowouts catastrophic	Buoc rute	Oimo	manaphor	5.68E-03	i i i i i i i i i i i i i i i i i i i
Holly - Blowouts any				1.42E-02	
Number of wells			24	1.422 02	Venoco Application 2005
Transor of world				-	MMS, 93% wellhead or drill floor, estimated redrills based
					on once every 15 years per well (as per paredon
Blowout during drilling - re-drills	4.84E-03	per well drilled	1.6	7.74E-03	Application, 2 redrills/year for approx 30 wells)
Blowout during drilling: re-drills below, platform release	3.64E-04	per well drilled	1.6		MMS, 7% subsea
, _F		p	1		HLID, 1992, gas well workovers, 93% wellhead or drill floor,
Blowout during well workover	9.70E-05	per well	24	2.33E-03	workovers every 7 years per well
		F =			HLID, 1992, gas well workovers, 7% subsea, assumes
Blowout during well workover: below platform release	7.30E-06	per well	24	1.75E-04	workovers every 7 years per well
,					HLID 1992, gas well production, 78% wellhead or drill floor,
Blowout during production	1.09E-04	per year	24	2.62E-03	Assumes gas lift wells under reservoir pressure
		1 . ,			HLID 1992, gas well production, 22% subsea, Assumes gas
Blowout during production: below platform release	3.08E-05	per year	24	7.39E-04	lift wells under reservoir pressure
Oil spill conditional probability	3.30E-01	per demand	1	3.30E-01	Catastrophic well blowout, MMS
		·			,
Holly - Wellhead Area Spill to Ocean - leak				2.21E-03	
Holly - Wellhead Area Spill to Ocean - rupture				6.28E-05	note: no drain system credit taken
Number of wellheads	24	number	1	2.40E+01	Current operation
Break of small fitting - after SSV	4.70E-04	per year	3	1.41E-03	HLID, 3 fittings per well
Pipe leak - after SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, piping after wells heads to separators, per
•		,			well
Pipe leak - after SSV - header	5.66E-05	/m.yr	25	1.42E-03	Rijnmond 1981, piping after headers to separators
Valve leak - after SSV	2.07E-04	/valve.yr	3	6.21E-04	HLID, Assume 90% are leaks, valves after SSV to
		,			separators, per well
Pipe rupture - after SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, after SSV to separators, per well
Pipe rupture - after SSV - header	9.00E-07	/m.yr	25		Rijnmond, Rupture of pipe, header to separators
Valve rupture - after SSV	2.30E-05	/valve.yr	3	6.90E-05	HLID, Assume 10% of leaks are rupture, after SSV to
·					separators, per well
Pipe leak - before SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, before SSV, per well
Valve leak - before SSV	2.07E-04	/valve.yr	6	1.24E-03	Rijnmond 1981 Assume 90% of leaks are significant, per
					well
Pipe rupture - before SSV	9.00E-07	/m.yr	10		Rijnmond, Rupture of pipe, per well
Valve rupture - before SSV	2.30E-05	/valve.yr	6	1.38E-04	Rijnmond, Assume 10% of leaks are catastrophic rupture,
					per well
Pipe leak - under Platform	1.40E-04	/m.yr	65	9.10E-03	
					protection, pipe length to ocean floor
Pipe rupture - under Platform	1.76E-06	/m.yr	65	1.14E-04	Rijnmond, Rupture of pipe, riser piping, no platform drain
					system protection, pipe length to ocean floor
	1				Lees, on demand failure to close, increased by 10 for sub
Failure to close sub surface valve	1.00E-02	per year	1		surface service
Failure to close surface safety valve	1.00E-03	per year	1	1.00E-03	Lees, on demand failure to close
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	

PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: Current Operations

Holly - Separator Failure Spill to Ocean - teak	Description	Base rate	Units	Multiplier	Rate	Ref
Holy - Separator Failure Spill to Ocean - rupture 2.36E-03 per year 2.60E-05 HLD 10% rupture 2.36E-03 per year 2.60E-05 per year 2.60E		24007410	· · · · · ·	a.c.pc.		
Vision Regularies						
Value require		3 00F-05	per vear	2		HLID, 10% rupture, 2 separators
Pipe registre						
Vissel leak						Ÿ
Besak of small timing						Commuted
Pipe leak						estiamted as twice the number of valves
Value leak						estiantied as twice the number of valves
Failure of chainage system						
Holly - Pumping and Shipping Spill to Ocean - leak 1.3.53E-02 1.519E-04						
Holly - Pumping and Shipping Spill to Ocean - rupture 2,30E-05 per year 2, 60E-06 2 surge-vessels	railure or drainage system	6.40E-02	on demand	'	6.40E-02	
Holly - Pumping and Shipping Spill to Ocean - rupture 2,30E-05 per year 2, 60E-06 2 surge-vessels	Hallis Brownian and Chinning Chill to Casen Jose				2 525 02	
Vase Rupture						
Valve tripture		2.005.05		0		0
Pipe Light 9.00E-07						Ŭ
Break of small fitting						2" valves and greater
Vassel lank						
Pipe leak						
Valve leak						
Pump leak or rupture						
Valve inie-up error during pigging						
Table Tabl	Pump leak or rupture	1.70E-02	per year	2	3.40E-02	
Incorrect reading of a gauge during pigging	Valve line-up error during pigging	0.01	probability per	1	1 005 02	Fail to reset valve: RM&IP
1.50E-03		0.01		'	1.00⊑-02	
Figure of drainage system	Incorrect reading of a gauge during pigging	4.50E-03		1	4.50E-03	Rijnmond, 1981
Failure of drainage system	Pigging operations per vear	34		1	34	Project description
Holly - Diesel Fuel Loading - Spill to Ocean						,
Lose failure			2 00010	<u> </u>	5OE OE	
Lose failure	Holly - Diesel Fuel Loading - Spill to Ocean				2 29F-01	
Loadings per year 5.20E+01 per year 1 5.20E+01 weekly, estimated		5 OOE O2	porvoor	- 1		CCBS hass rupture
Check valve failure						
Holly - External impact						
Holly - External impact						
Holly - General human error small misc material spills 2.73E-01 per year 1 2.73E-01 per year 1 2.73E-01 Based on historical data of smaller spills, 3 spills, 20 spills, 4 spills, 2 spills, 4 spills, 2 spills, 4 spills, 2 spills, 4 spills, 3 spills, 20 spills, 9 spi	Improper correction of linkage	4.40E-03	on demand	1	4.40E-03	Rijnmond, incorrect nose connection
Holly - General human error small misc material spills 2.73E-01 per year 1 2.73E-01 per year 1 2.73E-01 Based on historical data of smaller spills, 3 spills, 20 spills, 4 spills, 2 spills, 4 spills, 2 spills, 4 spills, 2 spills, 4 spills, 3 spills, 20 spills, 9 spi						Di Di IDi Di 14005 FID Financo 40
Holly - General human error small misc material spills 2.73E-01 per year 1 2.73E-01 over 11 years	Holly - External impact				1.00E-05	Pt. Ped Pt. Ped 1985 EIR, Figure 2-10
Holly - General human error small misc material spills 2.73E-01 per year 1 2.73E-01 over 11 years						
High wind	Holly - General human error small misc material spills	2.73E-01	per year	1	2.73E-01	
High wind	Helly Feilure of drainage system				6 405 03	
Valve falls opened/passes by 3.00E-04 per demand 3 9.00E-04 Rijnmond, leakage, 3 valves NC to water outfall 7ank T-4 or T-1 level alarm/switch failure 1.86E-02 1.86E-02 1.86E-02 CCPS, pump fails to start 2.20E-03 1.86E-02 CCPS, pump fails to start 2.20E-03 CCPS, failure of control valve per demand CCPS, failure of control valve per demand 2.20E-03 CCPS, failure of control valve per demand		4 205 02	nor domand	- 1		Daned on NOAA house 40050
Tank T-4 or T-1 level alarm/switch failure 3.00E-04 per demand 1 3.00E-04 Lees, limit switches Pump failure 1.86E-02 1 1.86E-02 CCPS, pump fails to start PCV fails closed/blocked on pump discharge 2.20E-03 1 2.20E-03 CCPS, failure of control valve per demand PIPELINE Freq/yr Probability Emulsion Pipeline - Failure rates Pipeline Rupture 8.14E-03 21.7 Pipeline Leak 3.93E-02 69.2 CSFM for this pipeline, leak 1.15E-02 per mile-year 3.03 3.48E-02 64.8 MMS pipeline throughput method, <50 bbl spill, per year						
Pump failure						
PIPELINE Emulsion Pipeline - Failure rates Pipeline Rupture Pipeline Leak CSFM for this pipeline, rupture CSFM for this pipel			per demand		3.00E-04	Lees, limit switches
PIPELINE Emulsion Pipeline - Failure rates Pipeline Rupture Pipeline Leak Pipeline Leak Pipeline Lieak Pipeline Introughput method, <50 bbl spill, per year Pipeline throughput method, <50 bbl spill, per year Pipeline Lieak Pipeline Lieak Pipeline Lieak Pipeline Horoughput method, <50 bbl spill, per year Pipeline Wave Impact on Beach Pipeline Wave Impact on Beach Pipeline Wave Impact on Beach Pipeline damage sufficient to rupture Pipeline Wave Impact on Beach Pipeline Wave Impact on Beach Pipeline Wave Impact on Beach Pipeline damage sufficient to rupture Pipeline damage sufficient to rupture Pipeline damage sufficient to rupture Pipeline Wave Impact on Beach Pipel						
Emulsion Pipeline - Failure rates Pipeline Rupture Pipeline Leak Pipeline Leak Pipeline Leak SEFM for this pipeline, leak MMS pipeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, leak Popeline, leak Po	PCV fails closed/blocked on pump discharge	2.20E-03		1	2.20E-03	CCPS, fallure of control valve per demand
Emulsion Pipeline - Failure rates Pipeline Rupture Pipeline Leak Pipeline Leak Pipeline Leak SEFM for this pipeline, leak MMS pipeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, rupture Popeline throughput method, <50 bbl spill, per year SEFM for this pipeline, leak Popeline, leak Po						
Emulsion Pipeline - Failure rates Pipeline Rupture Pipeline Leak CSFM for this pipeline, leak MMS pipeline throughput method, <50 bbl spill, per year CSFM for this pipeline, rupture CSFM for this pipeline, leak SOB 64.8 SOB 64.4 CSFM for this pipeline, leak SOB 64.8 SOB 66.4 CSFM for this pipeline, leak SOB 66.4 SOB 66.4 CSFM for this pipeline, leak SOB 66.4 S						
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Pipeline Rupture Pipeline Leak CSFM for this pipeline, leak MMS pipeline, throughput method, <50 bbl spill, per year CSFM for this pipeline, rupture SSCADA - failure CSFM for this pipeline, rupture CSFM for this pipeline, rupture SSCADA - failure CSFM for this pipeline, rupture CSFM for this pipeline, rupture SSCADA - failure SSCADA - failure CSFM for this pipeline, rupture SSCADA - failure	Emulsion Pipeline - Failure rates					
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CSFM for this pipeline, leak MMS pipeline throughput method, <50 bbl spill, per year CSFM for this pipeline, rupture CSSEM for this pipeline, rupture CSSEM for t						
MMS pipeline throughput method, <50 bbl spill, per year CSFM for this pipeline, rupture 2.52E-03 per mile-year 3.03 7.64E-03 20.5 OPS all crude lines, spills > 50 bbl 8.90E-04 per mile-year 3.03 2.70E-03 7.8 MMS pipeline throughput method, >50 bbl spill, per year 6.35E-03 17.3 Pipeline Wave Impact on Beach Severe wave impact Operator failure to inspect Mave impact causes pipeline damage sufficient to rupture Fraction of impacts to leak 9.00E-02 fraction 1.00E-01 per mile-year 3.03 7.64E-03 20.5 7.68 8.90E-03 7.8 Wave height greater than 4.5 meters. Frequency base and the source of the	i ipomio Ecak				0.002 02	00.2
MMS pipeline throughput method, <50 bbl spill, per year CSFM for this pipeline, rupture 2.52E-03 per mile-year 3.03 7.64E-03 20.5 OPS all crude lines, spills > 50 bbl 8.90E-04 per mile-year 3.03 2.70E-03 7.8 MMS pipeline throughput method, >50 bbl spill, per year 6.35E-03 17.3 Pipeline Wave Impact on Beach Severe wave impact Operator failure to inspect Mave impact causes pipeline damage sufficient to rupture Fraction of impacts to leak 9.00E-02 fraction 1.00E-01 per mile-year 3.03 7.64E-03 20.5 7.8 Mave height greater than 4.5 meters. Frequency base and the source of the	CSEM for this pipeline, look	1 155 02	por mile veer	2.02	2 40E 02	64.0
CSFM for this pipeline, rupture OPS all crude lines, spills > 50 bbl MMS pipeline throughput method, >50 bbl spill, per year Pipeline Wave Impact on Beach Severe wave impact Operator failure to inspect Wave impact causes pipeline damage sufficient to rupture Fraction of impacts to leak SCADA - failure 2.52E-03 per mile-year 3.03 7.64E-03 20.5 7.8 Wave height greater than 4.5 meters. Frequency base Bouy 107 Goleta Point 2002-2006. Wave height greater than 4.5 meters. Frequency base Bouy 107 Goleta Point 2002-2006. 1.00E-01 fraction 1 9.00E-02 fraction 1 1.00E-01 Failure to recognize incorrect status (RMIP). Estimated. Once per 10 years potential damage has occurred and 10% to rupture. Once per 10 years potential damage has occurred at to leak. SCADA - failure		1.136-02	per mile-year	3.03		
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OPS all crude lines, spills > 50 bbl MMS pipeline throughput method, >50 bbl spill, per year Pipeline Wave Impact on Beach Severe wave impact Operator failure to inspect Wave impact causes pipeline damage sufficient to rupture Fraction of impacts to leak SCADA - failure 8.90E-04 per mile-year 3.03 2.70E-03 7.8 Mave height greater than 4.5 meters. Frequency base Bouy 107 Goleta Point 2002-2006. Wave height greater than 4.5 meters. Frequency base Bouy 107 Goleta Point 2002-2006. 1.00E-01 fraction 1.00E-01 Failure to recognize incorrect status (RMIP). Estimated. Once per 10 years potential damage has occurred and 10% to rupture. Once per 10 years potential damage has occurred and 10% to rupture. SCADA - failure 1.01E-01 Reference	CSEM for this pipeline, meture	2 F2E 22	por mile	2.02	7.645.00	20.5
MMS pipeline throughput method, >50 bbl spill, per year Fipeline Wave Impact on Beach Severe wave impact South of the pipeline damage sufficient to rupture South of impacts to leak Severe wave impact South of the pipeline damage sufficient to rupture South of impacts to leak Severe wave impact South of the pipeline damage sufficient damage has occurred and 10% to rupture. Severe wave impact South of the pipeline damage sufficient damage has occurred and 10% to rupture. Severe wave impact causes pipeline damage sufficient to rupture South of the pipeline damage sufficient damage has occurred and 10% to rupture. Severe wave impact causes pipeline damage sufficient to rupture Severe wave impact South of the pipeline damage sufficient to rupture Severe wave impact South of the pipeline damage sufficient to rupture Severe wave impact South of the pipeline damage sufficient to rupture South of the pipeline damage sufficient to rupture						
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Severe wave impact Operator failure to inspect Mave height greater than 4.5 meters. Frequency base Bouy 107 Goleta Point 2002-2006. 1.00E-01 /demand 1 1.00E-01 Failure to recognize incorrect status (RMIP). Estimated. Once per 10 years potential damage has occurred and 10% to rupture. Fraction of impacts to leak 9.00E-02 fraction 1 9.00E-02 SCADA - failure 1.01E-01 Reference	iviivio pipeiine throughput method, >50 bbl spill, per year				ხ.პ5Է-03	11.3
Severe wave impact Operator failure to inspect Mave height greater than 4.5 meters. Frequency base Bouy 107 Goleta Point 2002-2006. 1.00E-01 /demand 1 1.00E-01 Failure to recognize incorrect status (RMIP). Estimated. Once per 10 years potential damage has occurred and 10% to rupture. Fraction of impacts to leak 9.00E-02 fraction 1 9.00E-02 SCADA - failure 1.01E-01 Reference	Discline West Investor 5					
Severe wave impact Departor failure to inspect Wave impact causes pipeline damage sufficient to rupture Fraction of impacts to leak SCADA - failure 1.00E-01 /yr 1 5.00E-01 Bouy 107 Goleta Point 2002-2006. How are impact to recognize incorrect status (RMIP). 1.00E-02 fraction 1 1.00E-02 Estimated. Once per 10 years potential damage has occurred and 10% to rupture. Once per 10 years potential damage has occurred are to leak. 1.00E-02 Fraction 1 1.00E-02 Reference	Pipeline Wave Impact on Beach					<u> </u>
Wave impact causes pipeline damage sufficient to rupture 1.00E-02 fraction 1 1.00E-02 Estimated. Once per 10 years potential damage has occurred and 10% to rupture. Once per 10 years potential damage has occurred are to leak. SCADA - failure 1.00E-02 Fraction 1 1.00E-02 Estimated. Once per 10 years potential damage has occurred are to leak.	Severe wave impact	5.00E-01	/yr	1	5.00E-01	
Wave impact causes pipeline damage sufficient to rupture 1.00E-02 fraction 1 1.00E-02 Estimated. Once per 10 years potential damage has occurred and 10% to rupture. Once per 10 years potential damage has occurred are to leak. SCADA - failure 1.00E-02 Fraction 1 1.00E-02 Estimated. Once per 10 years potential damage has occurred are to leak.	Operator failure to inspect	1.00E-01	/demand	1	1.00E-01	Failure to recognize incorrect status (RMIP).
Fraction of impacts to leak 9.00E-02 fraction 1 9.00E-02 Once per 10 years potential damage has occurred and to leak. SCADA - failure 1.01E-01 Reference	·					Estimated. Once per 10 years potential damage has
Fraction of impacts to leak 9.00E-02 fraction 1 9.00E-02 Once per 10 years potential damage has occurred at to leak. SCADA - failure 1.01E-01 Reference	wave impact causes pipeline damage sufficient to rupture	1.00E-02	rraction	1	1.00E-02	, , ,
SCADA - failure 1.01E-01 Reference	Fraction of impacts to leak	9.00E-02	fraction	1	9.00E-02	Once per 10 years potential damage has occurred and 90%
						100.00
Phono line failure 4 2 20E 04 Estimated 9 hours particle districts						
	Phone line failure	2.28E-04	demand	1		Estimated 8 hours per year down time
Pump shutdown failure 1.00E-04 on demand 1 1.00E-04 Rijnonmd, failure to stop on demand	Pump shutdown failure	1.00E-04	on demand	1		
Actuated valve failure 1.00E-03 on demand 1 1.00E-03 Lees, failure to operate on demand	Actuated valve failure	1.00E-03	on demand	1	1.00E-03	Lees, failure to operate on demand
Pressure Switch 1.00E-04 on demand 1 1.00E-04 Rijnonmd, failure on demand	Pressure Switch			1	1.00E-04	Rijnonmd, failure on demand
Operator Restarts system, override SCADA 1.00E-01 on demand 1 1.00E-01 R&MIP, Fail to recognize incorrect status on inspect	Operator Restarts system, override SCADA			1		
						·

PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: Current Operations

Rates and Age Factors		
Piping Failure Rate: Rupture	4.50E-07	Average between WASH, Rijnmond, Lees and CCPS
Piping Failure Rate: Leak	2.83E-05	Average between WASH, Rijnmond, Lees and CCPS
Piping Failure Rate: Rupture - adverse environment	8.80E-07	High value between WASH, Rijnmond, Lees and CCPS.
Piping Failure Rate: Leak - adverse environment	7.00E-05	High value between WASH, Rijnmond, Lees and CCPS
PSV lifts light	4.25E-02	Average value of WASH, Rijnmond, Lees and CCPS
PSV fraction of light lift that are wide open	0.1	Estimated based on general leak/rupture estimate of 10%.
Rule 331 Inspection Frequency	6	times/yr based on Venoco info
PSV inspection frequency	1	times/yr based on Venoco info
Piping age factor	2.0	Based on SPLIC data,
Vessel/Heat Exchanger age factor	2.0	Based on SPLIC data,

Platform Holly, Offshore Pipeline and Onshore Pipeline Failure Rate Calculations: Proposed Project

Summary of Frequency Inputs Lifetime

30 6150

years, estimated bpd over lifetime (oil only), estimated as 1/2 of peak production Average oil production, bpd

Platform Holly and Pipeline Summary	Current	Current	Proposed	Proposed
•		Lifetime Prob,	-	Lifetime Prob
Scenario	Freq, per year	%	Freq, per year	%
Holly and Offshore Pipeline				
Small Spills				
Holly - Blowouts any	1.42E-02	34.7	2.81E-02	57.0
Holly - Wellhead Area Spill to Ocean - leak	2.21E-03	6.4	2.76E-03	8.0
Holly - Separator Failure Spill to Ocean - leak	1.98E-03	5.8	1.98E-03	5.8
Holly - Pumping and Shipping Spill to Ocean - leak	3.53E-02	65.3	3.53E-02	65.3
Holly - Diesel Fuel Loading - Spill to Ocean	2.29E-01	99.9	2.29E-01	99.9
Holly - misc material spills	2.73E-01	100.0	2.73E-01	100.0
Pipeline: Emulsion offshore - leaks	3.93E-02	69.2	3.93E-02	69.2
Cumulative Small Spills	5.95E-01	100.0	6.10E-01	100.0
Large Spills				
Holly - Blowouts catastrophic	5.68E-03	15.7	1.10E-02	28.2
Holly - Wellhead area - rupture	6.28E-05	0.2	7.84E-05	0.2
Holly - Separator Failure Spill to Ocean - rupture	6.57E-04	2.0	6.57E-04	2.0
Holly - Pumping and Shipping Spill to Ocean - rupture	5.19E-04	1.5	5.19E-04	1.5
Holly - External impact	1.00E-05	0.0	1.00E-05	0.0
Pipeline: Emulsion offshore - ruptures	8.14E-03	21.7	8.14E-03	21.7
Cumulative Large Spills	1.51E-02	36.4	2.04E-02	45.8
Onshore Pipeline				
Pipeline: EOF-AACP - leaks	na	na	3.25E-02	62
Pipeline: EOF-AACP - ruptures	na	na	7.15E-03	19

Detailed Calculations					
PLATFORM HOLLY					
Description	Base rate	Units	Multiplier	Rate	Ref
Holly - Blowouts catastrophic			•	1.10E-02	
Holly - Blowouts any				2.81E-02	
Number of wells			30		Venoco Application 2005, assumes all slots are active
Blowout during drilling: new wells	4.84E-03	per well drilled	2	9.67E-03	MMS, 93% wellhead or drill floor, an estimated average of 3 wells per year drilled during the drilling phase
Blowout during drilling: new wells, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
Blowout during drilling: re-drills	4.84E-03	per well drilled	2	9.67E-03	MMS, 93% wellhead or drill floor, estimated redrills based on once every 15 years per well (as per paredon Application, 2 redrills/year for approx 30 wells)
Blowout during drilling: re-drills, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
Blowout during well workover	9.70E-05	per well	30	2.91E-03	HLID, 1992, gas well workovers, 93% wellhead or drill floor, workovers every 7 years per well
Blowout during well workover: below platform release	7.30E-06	per well	30	2.19E-04	HLID, 1992, gas well workovers, 7% subsea, assumes workovers every 7 years per well
Blowout during production	1.09E-04	per year	30	3.28E-03	HLID 1992, gas well production, 78% wellhead or drill floor, Assumes gas lift wells under reservoir pressure. Eventual conversion to ESP not included.
Blowout during production: below platform release	3.08E-05	per year	30	9.24E-04	HLID 1992, gas well production, 22% subsea, Assumes gas lift wells under reservoir pressure.
Oil spill conditional probability	3.30E-01	per demand	1	3.30E-01	Catastrophic well blowout, MMS

Platform Holly, Offshore Pipeline and Onshore Pipeline Failure Rate Calculations: Proposed Project

Description	
Monther of wellinged Area Spill to Ocean - rupture 1 3.056-10 1.3056-10	
Number of wellheads	an
Besak of small fitting - after SSV	711
Pipe leak - after SSV	
Pipe leak - after SSV - header	s hoods to congretors
Eppe lask- arbert SSV	s riedus to separators,
Valve losk - after SSV 2.07E-04	ders to senarators
Pipe rupture - after SSV	
Pipe rupture - after SSV	aives aiter cov to
Pipe rupture - after SSV - header	SSV to separators, per
Pipe turbure - after SSV	COV to ocparatoro, por
Valve rupture - after SSV	ler to separators
Separators SV	
Pipe leak - before SSV	raptaro, anor oor to
Valve lask - before SSV	r well
Pipe rupture - before SSV	
Pipe Tupture - before SSV	iouno uno oigrimouni,
Valve rupture - before SSV 2.30E-05 /valve yr 6 1.38E-04 Rijmmond, Assume 10% of leaks are can prupture, per well Pipe leak - under Platform 1.40E-04 /m.yr 65 9.10E-03 Rijmmond 1981, riser piping, no platform Pipe rupture - under Platform 1.76E-06 /m.yr 65 1.14E-04 Rijmmond, Rupture of pipe, inser piping, no platform are valve 1.00E-02 per year 1 1.00E-03 Rijmmond, Rupture of pipe, inser piping, or platform are valve are valve 1.00E-02 per year 1 1.00E-03 Lees, on demand failure to close increases valve 1.00E-03 per year 1 1.00E-03 Lees, on demand failure to close increases valve 1.00E-03 per year 1 1.00E-03 Lees, on demand failure to close increases valve 6.40E-02 on demand 1 6.40E-03 Lees, on demand failure to close increases valve 6.57E-04 Lees, on demand failure to close increases valve are valve	vell
Pipe lask - under Platform	
Pipe lask - under Platform	·
Pipe rupture - under Platform	platform drain system
Pipe rupture - under Platform	
Failure to close sub surface valve	
Failure to close sub surface valve	
Failure to close sub surface valve	e, increased by 10 for
Failure to close surface safety valve	.,
Holly - Separator Failure Spill to Ocean - leak Holly - Separator Failure Spill to Ocean - rupture Superator Superator Superator Superator Superator Superator Su	,
Holly - Separator Failure Spill to Ocean - leak 1.98E-03	
Holly - Separator Failure Spill to Ocean - rupture 3.00E-05 per year 2 6.00E-05 HLID. 10% rupture, 2 separators 2 valve upture 2.30E-05 /valve.yr 24 5.52E-04 2 valves and greater 2	
Holly - Separator Failure Spill to Ocean - rupture 3.00E-05 per year 2 6.00E-05 HLID. 10% rupture, 2 separators 2 valve upture 2.30E-05 /valve.yr 24 5.52E-04 2 valves and greater 2	
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Valve rupture	
Pipe rupture	
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Ereak of small fitting	
Fige leak	of valves
Valve leak	
Failure of drainage system	
Holly - Pumping and Shipping Spill to Ocean - leak	
Holly - Pumping and Shipping Spill to Ocean - rupture 2.30E-05 2.30E-02 2.30E-03 2.30E-02 2.30E-03 2.30E-02 2.30E-03 2.30E-02 2.30E-03 2.30E-02 2.30E-03 2.30E-02 2.30E-03 2.30E-03	
Holly - Pumping and Shipping Spill to Ocean - rupture 2.30E-05 2.30E-02 2.30E-03 2.30E-02 2.30E-03 2.30E-02 2.30E-03 2.30E-02 2.30E-03 2.30E-03	
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Break of small fitting	
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Incorrect reading of a gauge during pigging 4.50E-03 Pigging operations per year Failure of drainage system 6.40E-02 Holly - Diesel Fuel Loading - Spill to Ocean Hose failure 5.00E-03 Per year 5.00E-03 Per year 5.00E-03 Per year 5.20E+01 Per year 5.20E+01 Per year Check valve failure 2.20E-03 Per demand 1.00E-05 Pt. Ped Pt. Ped 1985 EIR, Figure 2-10 Based on historical data of smaller spille	
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Holly - External impact 1.00E-05 Pt. Ped Pt. Ped 1985 EIR, Figure 2-10 Based on historical data of smaller spills	ction
Based on historical data of smaller spills	J. 1011
Based on historical data of smaller spills	e 2-10
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	ler spills 3 smaller spills
priory denotes member offer animal mise material apina 2.75E-01 per year 1 2.75E-01 Over 11 years	ioi opino, o sinanci spins
Holly - Failure of drainage system 6.40E-02	
High wind 4.20E-02 per demand 1 4.20E-02 Based on NOAA buoy 46053 > 20 mph	20 mnh
Valve fails opened/passes by 3.00E-04 per demand 3 9.00E-04 Rijnmond, leakage, 3 valves NC to wate	
	water Utiliail
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	or domand
PCV fails closed/blocked on pump discharge 2.20E-03 1 2.20E-03 CCPS, failure of control valve per dema	n demand

Platform Holly, Offshore Pipeline and Onshore Pipeline Failure Rate Calculations: Proposed Project

PIPELINES				Freq/yr	Probability
Description	Base rate	Units	Multiplier	Rate	Ref
Emulsion Pipeline - Failure rates					
Pipeline Rupture				8.14E-03	21.7
Pipeline Leak				3.93E-02	69.2
CSFM for this pipeline, leak	1.15E-02	per mile-year	3.03	3.48E-02	64.8
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
CSFM for this pipeline, rupture	2.52E-03	per mile-year	3.03	7.64E-03	20.5
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	3.03	2.70E-03	7.8
MMS pipeline throughput method, >50 bbl spill, per year				1.30E-02	32.3
Pipeline Wave Impact on Beach					
Severe wave impact	5.00E-01	/yr	1	5.00E-01	Wave height greater than 4.5 meters. Frequency based on Bouy 107 Goleta Point 2002-2006.
Operator failure to inspect	1.00E-01	/demand	1	1.00E-01	Failure to recognize incorrect status (RMIP).
Operator failure to inspect	1.00E-01	/demand		1.00E-01	Estimated. Once per 10 years potential damage has
Wave impact causes pipeline damage sufficient to rupture	1.00E-02	fraction	1	1.00E-02	occurred and 10% to rupture.
Fraction of impacts to leak	9.00E-02	fraction	1	9.00E-02	Once per 10 years potential damage has occurred and
, , , , , , , , , , , , , , , , , , , ,					90% to leak.
Onshore EOF- AACP Pipeline - Failure rates					
CSFM for this pipeline, leak	3.83E-03	per mile-year	8.50	3.25E-02	62.3
MMS pipeline throughput method, <50 bbl spill, per year		İ		7.45E-02	89.3
CSFM for this pipeline, rupture	8.41E-04	per mile-year	8.50	7.15E-03	19.3
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	8.50	7.57E-03	20.3
MMS pipeline throughput method, >50 bbl spill, per year		İ		1.30E-02	32.3
SCADA - failure				1.01E-01	Reference
Phone line failure	2.28E-04	demand	1	2.28E-04	Estimated 8 hours per year down time
Pump shutdown failure	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure to stop on demand
Actuated valve failure	1.00E-03	on demand	1	1.00E-03	Lees, failure to operate on demand
Pressure Switch	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure on demand
Operator Restarts system, override SCADA	1.00E-01	on demand	1	1.00E-01	R&MIP, Fail to recognize incorrect status on inspection

PLATFORM HOLLY and Onshore Pipeline Failure Rate Calculations: Holly Processing Alternative

Summary of Frequency Inputs

Oil spill conditional probability

30 6150 Lifetime

years, estimated bpd over lifetime (oil only), estimated as 1/2 of peak production Average oil production, bpd

Platform Holly and Pipeline Summary	Current	Current	Proposed	Proposed]
, ,	Freq, per	Lifetime	Freq, per	Lifetime	1
Scenario	year	Prob. %	year	Prob, %	
Holly and Offshore Pipeline		, i		,	1
Small Spills					1
Holly - Blowouts any	1.42E-02	34.7	2.81E-02	57.0	1
Holly - Wellhead Area Spill to Ocean - leak	2.21E-03	6.4	2.21E-03	6.4	1
Holly - Separator/Oil Processing Failure Spill to Ocean - leak	1.98E-03	5.8	7.87E-03	21.0	1
Holly - Pumping and Shipping Spill to Ocean - leak	3.53E-02	65.3	3.53E-02	65.3	1
Holly - Diesel Fuel Loading - Spill to Ocean	2.29E-01	99.9	2.29E-01	99.9	1
Holly - misc material spills	2.73E-01	100.0	2.73E-01	100.0	1
Pipeline: Emulsion offshore - leaks	3.93E-02	69.2	3.93E-02	69.2	1
Cumulative Small Spills	5.95E-01	100.0	6.15E-01	100.0	1
Large Spills					1
Holly - Blowouts catastrophic	5.68E-03	15.7	1.10E-02	28.2	1
Holly - Wellhead area - rupture	6.28E-05	0.2	6.28E-05	0.2	1
Holly - Separator/Oil Processing Failure Spill to Ocean - rupture	6.57E-04	2.0	2.57E-03	7.4	1
Holly - Pumping and Shipping Spill to Ocean - rupture	5.19E-04	1.5	5.19E-04	1.5	1
Holly - External impact	1.00E-05	0.0	1.00E-05	0.0	1
Pipeline: Emulsion offshore - ruptures	8.14E-03	21.7	8.14E-03	21.7	1
Cumulative Large Spills	1.51E-02	36.4	2.23E-02	48.8	1
Onshore Pipeline					
Pipeline: EOF-AACP - leaks	na	na	3.25E-02	62.3	1
Pipeline: EOF-AACP - ruptures	na	na	7.15E-03	19.3	1
					-
Detailed Calculations					
PLATFORM HOLLY					
Description	Base rate	Units	Multiplier	Rate	Ref
Holly - Blowouts catastrophic				1.10E-02	
Holly - Blowouts any				2.81E-02	
Number of wells			30		Venoco Application 2005, assumes all slots are activ
					MMS, 93% wellhead or drill floor, an estimated
					average of 3 wells per year drilled during the drilling
Blowout during drilling: new wells	4.84E-03	per well drilled	2	9.67E-03	phase
Blowout during drilling: new wells, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
2.000 at a annual annual and a second place and a s	0.0.2.0.	por won annou		11202 01	MMS, 93% wellhead or drill floor, estimated redrills
					based on once every 15 years per well (as per
					paredon Application, 2 redrills/year for approx 30
Blowout during drilling: re-drills	4.84E-03	per well drilled	2	9.67E-03	wells)
Blowout during drilling: re-drills, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
	0.0.2.01		_	7.202 01	HLID, 1992, gas well workovers, 93% wellhead or dri
Blowout during well workover	9.70E-05	per well	30	2.91E-03	floor, workovers every 7 years per well
	3 52 50	po			HLID, 1992, gas well workovers, 7% subsea,
Blowout during well workover: below platform release	7.30E-06	per well	30	2.19E-04	assumes workovers every 7 years per well
					HLID 1992, gas well production, 78% wellhead or dri
					floor, Assumes gas lift wells under reservoir pressure
Blowout during production	1.09E-04	per year	30	3.28E-03	Eventual conversion to ESP not included.
					HLID 1992, gas well production, 22% subsea,
					Assumes no production wells under reservoir
	3.08E-05			9.24E-04	pressure

3.30E-01 per demand

3.30E-01 Catastrophic well blowout, MMS

PLATFORM HOLLY and Onshore Pipeline Failure Rate Calculations: Holly Processing Alternative

Description	Base rate	Units	Multiplier	Rate	Ref
Holly - Wellhead Area Spill to Ocean - leak				2.21E-03	
Holly - Wellhead Area Spill to Ocean - rupture				6.28E-05	note: no drain system credit taken
Number of wellheads	24	number	1	2.40E+01	Current operation
Break of small fitting - after SSV	4.70E-04	per year	3	1.41E-03	HLID, 3 fittings per well
Pipe leak - after SSV	5.66E-05		10	5.66E-04	Rijnmond 1981, piping after wells heads to
Pipe leak - aiter 55V	3.00⊑-03	/m.yr	10	5.00⊑-04	
5: 1 1 6 001/ 1 1	5.005.05	,	0.5	4 405 00	separators, per well
Pipe leak - after SSV - header	5.66E-05	/m.yr	25	1.42E-03	Rijnmond 1981, piping after headers to separators
Valve leak - after SSV	2.07E-04	/valve.yr	3	6.21E-04	HLID, Assume 90% are leaks, valves after SSV to
					separators, per well
Pipe rupture - after SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, after SSV to separators,
					per well
Pipe rupture - after SSV - header	9.00E-07	/m.yr	25	2.25E-05	Rijnmond, Rupture of pipe, header to separators
Valve rupture - after SSV	2.30E-05	/valve.yr	3	6.90E-05	HLID, Assume 10% of leaks are rupture, after SSV to
		,			separators, per well
Pipe leak - before SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, before SSV, per well
Valve leak - before SSV	2.07E-04	/valve.yr	6	1.24E-03	Rijnmond 1981 Assume 90% of leaks are significant,
Valvo loak bololo dev	2.07 2 0 1	/vaivo.yi	Ü	1.212 00	per well
Pipe rupture - before SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, per well
Valve rupture - before SSV	2.30E-05		6	1.38E-04	Rijnmond, Assume 10% of leaks are catastrophic
valve rupture - belore 55 v	2.30⊑-05	/valve.yr	0	1.30⊑-04	
5: 1 1 1 1 1 1 1 1 1 1	4.405.04	,	0.5	0.405.00	rupture, per well
Pipe leak - under Platform	1.40E-04	/m.yr	65	9.10E-03	Rijnmond 1981, riser piping, no platform drain system
					protection, pipe length to ocean floor
Pipe rupture - under Platform	1.76E-06	/m.yr	65	1.14E-04	Rijnmond, Rupture of pipe, riser piping, no platform
					drain system protection, pipe length to ocean floor
					Lees, on demand failure to close, increased by 10 for
Failure to close sub surface valve	1.00E-02	per year	1	1.00E-02	sub surface service
Failure to close surface safety valve	1.00E-03	per year	1	1.00E-03	Lees, on demand failure to close
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	Ecco, on demand landro to close
l allule of dialitage system	0.40L-02	on demand		0.40L-02	
Haller Conservation/Oil Brassesium Failum Cuill to Occur. Joseph				7.87E-03	
Holly - Separator/Oil Processing Failure Spill to Ocean - leak					
Holly - Separator/Oil Processing Failure Spill to Ocean - ruptu				2.57E-03	
Vessel Rupture	3.00E-05	per year	4	1.20E-04	HLID, 10% rupture, 2 separators, 2 vessels
				5.96E-05	
Heat exchanger rupture	1.49E-05	per year	4		HLID, 10% rupture, 4 exchangers including therminol
Valve rupture	2.30E-05	/valve.yr	96	2.21E-03	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	200	1.80E-04	
		,			estimated pipe lengths at 25m per vessel/exchanger
Vessel leak	3.00E-04	per year	4	1.20E-03	January Park Strategy
Heat exchanger leak	1.49E-04	per year	2	2.98E-04	HLID,90% leak
Break of small fitting	4.70E-04	per year	192	9.02E-02	estimated as twice the number of valves
Pipe leak	5.66E-05	/m.yr	200	1.13E-02	estimated as twice the number of valves
				1.13E-02 1.99E-02	
Valve leak	2.07E-04	/valve.yr	96		
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
Holly - Pumping and Shipping Spill to Ocean - leak				3.53E-02	
Holly - Pumping and Shipping Spill to Ocean - rupture				5.19E-04	
Vessel Rupture	3.00E-05	per year	2	6.00E-05	2 surge vessels
Valve rupture	2.30E-05	/valve.yr	18	4.14E-04	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	50	4.50E-05	·
Break of small fitting	4.70E-04	per year	36	1.69E-02	
Vessel leak	3.00E-04	per year	2	6.00E-04	
Pipe leak	5.66E-05	/m.yr	50	2.83E-03	
Valve leak	2.07E-04		18	3.73E-03	
		/valve.yr	_		LILID 4000
Pump leak or rupture	1.70E-02	per year	2	3.40E-02	HLID, 1992
Valve line-up error during pigging	0.01	probability	1	1.00E-02	Fail to reset valve: RM&IP
	****	per task			
Incorrect reading of a gauge during pigging	4.50E-03	probability	1	4.50E-03	Rijnmond, 1981
	4.50E-03	per task	<u>'</u>	4.50⊑-03	
Pigging operations per year	34	number	1	34	Project description
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
· ,					
Holly - Diesel Fuel Loading - Spill to Ocean	1			2.29E-01	
Hose failure	+	per year	1	5.00E-03	CCPS, hose rupture
	5 00-02				IOOI O, IIO3E IUPIUIE
	5.00E-03				
Loadings per year	5.20E+01	per year	1	5.20E+01	weekly, estimated
Loadings per year Check valve failure	5.20E+01 2.20E-03	per year per demand	1	5.20E+01 2.20E-03	weekly, estimated CCPS, 1989, Failure to check
Loadings per year	5.20E+01	per year	1	5.20E+01	weekly, estimated

PLATFORM HOLLY and Onshore Pipeline Failure Rate Calculations: Holly Processing Alternative

Description	Base rate	Units	Multiplier	Rate	Ref
Holly - External impact			•	1.00E-05	Pt. Ped Pt. Ped 1985 EIR, Figure 2-10
					, 0
					Based on historical data of smaller spills, 3 smaller
Holly - General human error small misc material spills	2.73E-01	per year	1	2.73E-01	spills over 11 years
,					
Holly - Failure of drainage system				6.40E-02	
High wind	4.20E-02	per demand	1	4.20E-02	Based on NOAA buoy 46053 > 20 mph
Valve fails opened/passes by	3.00E-04	per demand	3	9.00E-04	Rijnmond, leakage, 3 valves NC to water outfall
Tank T-4 or T-1 level alarm/switch failure	3.00E-04	per demand	1	3.00E-04	Lees, limit switches
Pump failure	1.86E-02		1	1.86E-02	CCPS, pump fails to start
PCV fails closed/blocked on pump discharge	2.20E-03		1	2.20E-03	CCPS, failure of control valve per demand
PIPELINE				Freq/yr	Probability
Emulsion Pipeline - Failure rates		1		0.445.00	04.7
Pipeline Rupture				8.14E-03	21.7
Pipeline Leak				3.93E-02	69.2
CCEM for this pinaling, look	4.455.00		2.02	2.405.00	C4.0
CSFM for this pipeline, leak	1.15E-02	per mile-year	3.03	3.48E-02	64.8
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
CCEM for this minution, must us	2.52E-03		3.03	7.64E-03	20.5
CSFM for this pipeline, rupture OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year per mile-year	3.03		20.5 7.8
MMS pipeline throughput method, >50 bbl spill, per year	0.9UE-U4	per mile-year	3.03	2.70E-03 1.30E-02	
www.s pipeline throughput method, >50 bbi spill, per year				1.30E-02	32.3
Pipeline Wave Impact on Beach					
	500504	,		5 00F 04	Wave height greater than 4.5 meters. Frequency
Severe wave impact	5.00E-01	/yr	1	5.00E-01	based on Bouy 107 Goleta Point 2002-2006.
Operator failure to inspect	1.00E-01	/demand	1	1.00E-01	Failure to recognize incorrect status (RMIP).
Wave impact causes pipeline damage sufficient to rupture	1.00E-02	fraction	1	1.00E-02	Estimated. Once per 10 years potential damage has occurred and 10% to rupture.
Fraction of impacts to leak	9.00E-02	fraction	1	9.00E-02	90% to leak.
Tradition of impacts to loak	0.002 02	iradion		0.002 02	0070 to locate.
Onshore EOF- AACP Pipeline - Failure rates					
CSFM for this pipeline, leak	3.83E-03	per mile-year	8.50	3.25E-02	62.3
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
p.p gp					
CSFM for this pipeline, rupture	8.41E-04	per mile-year	8.50	7.15E-03	19.3
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	8.50	7.57E-03	20.3
MMS pipeline throughput method, >50 bbl spill, per year	1			1.30E-02	32.3
SCADA - failure				1.01E-01	Reference
Phone line failure	2.28E-04	demand	1	2.28E-04	Estimated 8 hours per year down time
Pump shutdown failure	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure to stop on demand
Actuated valve failure	1.00E-03	on demand	1	1.00E-03	Lees, failure to operate on demand
Pressure Switch	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure on demand
					R&MIP, Fail to recognize incorrect status on
Operator Restarts system, override SCADA	1.00E-01	on demand	1	1.00E-01	inspection
			•		

PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: LFC Offshore Pipeline

Summary of Frequency Inputs Lifetime Average oil production, bpd

30 6150

years, estimated bpd over lifetime (oil only), estimated as 1/2 of peak production

Platform Holly and Pipeline Summary	Current	Current	LFC Alt	LFC Alt
	Freq, per	Lifetime Prob,	Freq, per	Lifetime
Scenario	year	%	year	Prob, %
Small Spills				
Holly - Blowouts any	1.42E-02	34.7	2.81E-02	57.0
Holly - Wellhead Area Spill to Ocean - leak	2.21E-03	6.4	2.76E-03	8.0
Holly - Separator Failure Spill to Ocean - leak	1.98E-03	5.8	1.98E-03	5.8
Holly - Pumping and Shipping Spill to Ocean - leak	3.53E-02	65.3	3.53E-02	65.3
Holly - Diesel Fuel Loading - Spill to Ocean	2.29E-01	99.9	2.29E-01	99.9
Holly - misc material spills	2.73E-01	100.0	2.73E-01	100.0
Pipeline: Emulsion offshore - leaks	3.93E-02	69.2	3.93E-02	69.2
Cumulative Small Spills	5.95E-01	100.0	6.10E-01	100.0
Large Spills				
Holly - Blowouts catastrophic	5.68E-03	15.7	1.10E-02	28.2
Holly - Wellhead area - rupture	6.28E-05	0.2	7.84E-05	0.2
Holly - Separator Failure Spill to Ocean - rupture	6.57E-04	2.0	6.57E-04	2.0
Holly - Pumping and Shipping Spill to Ocean - rupture	5.19E-04	1.5	5.19E-04	1.5
Holly - External impact	1.00E-05	0.0	1.00E-05	0.0
Pipeline: Emulsion offshore - ruptures	8.14E-03	21.7	8.14E-03	21.7
Cumulative Large Spills	1.51E-02	36.4	2.04E-02	45.8
Pipeline Holly - LFC				
Pipeline: Holly LFC - leaks	na	na	4.06E-02	70
Pipeline: Holly LFC - ruptures	na	na	8.91E-03	23

Detailed Calculations					
PLATFORM HOLLY					
Description	Base rate	Units	Multiplier	Rate	Ref
Holly - Blowouts catastrophic				1.10E-02	
Holly - Blowouts any				2.81E-02	
Number of wells			30		Venoco Application 2005, assumes all slots are active
					MMS, 93% wellhead or drill floor, an estimated average of
Blowout during drilling: new wells	4.84E-03	per well drilled	2	9.67E-03	3 wells per year drilled during the drilling phase
Blowout during drilling: new wells, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
					MMS, 93% wellhead or drill floor, estimated redrills based
					on once every 15 years per well (as per paredon
Blowout during drilling: re-drills	4.84E-03	per well drilled	2	9.67E-03	Application, 2 redrills/year for approx 30 wells)
Blowout during drilling: re-drills, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
					HLID, 1992, gas well workovers, 93% wellhead or drill
Blowout during well workover	9.70E-05	per well	30	2.91E-03	floor, workovers every 7 years per well
					HLID, 1992, gas well workovers, 7% subsea, assumes
Blowout during well workover: below platform release	7.30E-06	per well	30	2.19E-04	workovers every 7 years per well
					HLID 1992, gas well production, 78% wellhead or drill floor,
					Assumes gas lift wells under reservoir pressure. Eventual
Blowout during production	1.09E-04	per year	30	3.28E-03	conversion to ESP not included.
			•		HLID 1992, gas well production, 22% subsea, Assumes
Blowout during production: below platform release	3.08E-05	per year	30	9.24E-04	gas lift wells under reservoir pressure.
Oil spill conditional probability	3.30E-01	per demand	1	3.30E-01	Catastrophic well blowout, MMS
_			•		

PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: LFC Offshore Pipeline

Holly - Wellhead Area Spill to Ocean - leak				2.76E-03	
Holly - Wellhead Area Spill to Ocean - rupture				7.84E-05	note: no drain system credit taken
Number of wellheads	30	number	1	3.00E+01	Current operation
Break of small fitting - after SSV	4.70E-04	per year	3	1.41E-03	HLID, 3 fittings per well
Pipe leak - after SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, piping after wells heads to separators, per well
Pipe leak - after SSV - header	5.66E-05	/m.yr	25	1.42E-03	Rijnmond 1981, piping after headers to separators
Valve leak - after SSV	2.07E-04	/valve.yr	3	6.21E-04	HLID, Assume 90% are leaks, valves after SSV to
Pipe rupture - after SSV	9.00E-07	/m.yr	10	9.00E-06	separators, per well Rijnmond, Rupture of pipe, after SSV to separators, per
Pipe rupture - after SSV - header	9.00E-07	/m.yr	25	2.25E-05	well Rijnmond, Rupture of pipe, header to separators
Valve rupture - after SSV	2.30E-05	/valve.yr	3	6.90E-05	HLID, Assume 10% of leaks are rupture, after SSV to separators, per well
Pipe leak - before SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, before SSV, per well
Valve leak - before SSV	2.07E-04	/valve.yr	6	1.24E-03	Rijnmond 1981 Assume 90% of leaks are significant, per well
Pipe rupture - before SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, per well
Valve rupture - before SSV	2.30E-05	/valve.yr	6	1.38E-04	Rijnmond, Assume 10% of leaks are catastrophic rupture, per well
Pipe leak - under Platform	1.40E-04	/m.yr	65	9.10E-03	Rijnmond 1981, riser piping, no platform drain system protection, pipe length to ocean floor
Pipe rupture - under Platform	1.76E-06	/m.yr	65	1.14E-04	Rijnmond, Rupture of pipe, riser piping, no platform drain system protection, pipe length to ocean floor
				Ì	Lees, on demand failure to close, increased by 10 for sub
Failure to close sub surface valve	1.00E-02	per year	1	1.00E-02	surface service
Failure to close surface safety valve	1.00E-03	per year	1	1.00E-03	Lees, on demand failure to close
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
Holly - Separator Failure Spill to Ocean - leak				1.98E-03	
Holly - Separator Failure Spill to Ocean - rupture				6.57E-04	
Vessel Rupture	3.00E-05	per year	2	6.00E-05	HLID, 10% rupture, 2 separators
Valve rupture	2.30E-05	/valve.yr	24	5.52E-04	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	50	4.50E-05	estimated
Vessel leak	3.00E-04	per year	2	6.00E-04	
Break of small fitting	4.70E-04	per year	48	2.26E-02	estiamted as twice the number of valves
Pipe leak	5.66E-05	/m.yr	50	2.83E-03	octamica de timos trio mambor en varios
Valve leak	2.07E-04	/valve.yr	24	4.97E-03	
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
•					
Holly - Pumping and Shipping Spill to Ocean - leak	ļ			3.53E-02	
Holly - Pumping and Shipping Spill to Ocean - rupture				5.19E-04	
Vessel Rupture	3.00E-05	per year	2	6.00E-05	2 surge vessels
Valve rupture	2.30E-05	/valve.yr	18	4.14E-04	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	50	4.50E-05	
Break of small fitting	4.70E-04	per year	36	1.69E-02	
Vessel leak	3.00E-04	per year	2	6.00E-04	
Pipe leak	5.66E-05	/m.yr	50	2.83E-03	
Valve leak	2.07E-04	/valve.yr	18	3.73E-03	
Pump leak or rupture	1.70E-02	per year	2	3.40E-02	HLID, 1992
Valve line-up error during pigging	0.01	probability per	1	1.00E-02	Fail to reset valve: RM&IP
Incorrect reading of a gauge during pigging	4.50E-03	probability per	1	4.50E-03	Rijnmond, 1981
Pigging operations per year	34	number	11	34	Project description
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
Holly - Diesel Fuel Loading - Spill to Ocean				2.29E-01	
Hose failure	5.00E-03	per year	1	5.00E-03	CCPS, hose rupture
Loadings per year	5.20E+01	per year	1	5.20E+01	weekly, estimated
Check valve failure	2.20E-03	per demand	1	2.20E-03	CCPS, 1989, Failure to check
Improper correction of linkage	4.40E-03	on demand	1	4.40E-03	Rijnmond, incorrect hose connection
Holly - External impact				1.00E-05	Pt. Ped Pt. Ped 1985 EIR, Figure 2-10
Holly - General human error small misc material spills	2.73E-01	per year	1	2.73E-01	Based on historical data of smaller spills, 3 smaller spills over 11 years
Holly - Failure of drainage system				6.40E-02	
High wind	4.20E-02	per demand	1	4.20E-02	Based on NOAA buoy 46053 > 20 mph
Valve fails opened/passes by	3.00E-04	per demand	3	9.00E-04	Rijnmond, leakage, 3 valves NC to water outfall
Tank T-4 or T-1 level alarm/switch failure	3.00E-04	per demand	1	3.00E-04	Lees, limit switches
Pump failure	1.86E-02		1	1.86E-02	CCPS, pump fails to start
PCV fails closed/blocked on pump discharge	2.20E-03		1	2.20E-03	CCPS, failure of control valve per demand
					+
				İ	
				•	

PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: LFC Offshore Pipeline

PIPELINE				Freq/yr	Probability
Emulsion Pipeline Holly-EOF - Failure rates					
Pipeline Rupture				8.14E-03	21.7
Pipeline Leak				3.93E-02	69.2
CSFM for this pipeline, leak	1.15E-02	per mile-year	3.03	3.48E-02	64.8
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
CSFM for this pipeline, rupture	2.52E-03	per mile-year	3.03	7.64E-03	20.5
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	3.03	2.70E-03	7.8
MMS pipeline throughput method, >50 bbl spill, per year	3.55= 5.			1.30E-02	32.3
Pipeline Holly-EOF Wave Impact on Beach					
Severe wave impact	5.00E-01	/yr	1	5.00E-01	Wave height greater than 4.5 meters. Frequency based on Bouy 107 Goleta Point 2002-2006.
Operator failure to inspect	1.00E-01	/demand	1	1.00E-01	Failure to recognize incorrect status (RMIP).
Wave impact causes pipeline damage sufficient to rupture	1.00E-02	fraction	1	1.00E-02	Estimated. Once per 10 years potential damage has occurred and 10% to rupture.
Fraction of impacts to leak	9.00E-02	fraction	1	9.00E-02	90% to leak.
Offshore Holly - LFC Pipeline - Failure rates					
CSFM for this pipeline, leak	3.83E-03	per mile-year	10.60	4.06E-02	70.4
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
CSFM for this pipeline, rupture	8.41E-04	per mile-year	10.60	8.91E-03	23.5
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	10.60	9.43E-03	24.6
MMS pipeline throughput method, >50 bbl spill, per year				1.30E-02	32.3
SCADA - failure				1.01E-01	Reference
Phone line failure	2.28E-04	demand	1	2.28E-04	Estimated 8 hours per year down time
Pump shutdown failure	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure to stop on demand
Actuated valve failure	1.00E-03	on demand	1	1.00E-03	Lees, failure to operate on demand
Pressure Switch	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure on demand
Operator Restarts system, override SCADA	1.00E-01	on demand	11	1.00E-01	R&MIP, Fail to recognize incorrect status on inspection